



TITLE:

Four Species of the Genus Grandidierella (Crustacea : Amphipoda : Aoridae) from Osaka Bay and the Northern Part of the Kii Channel, Central Japan

AUTHOR(S):

Ariyama, Hiroyuki

CITATION:

Ariyama, Hiroyuki. Four Species of the Genus *Grandidierella* (Crustacea : Amphipoda : Aoridae) from Osaka Bay and the Northern Part of the Kii Channel, Central Japan. PUBLICATIONS OF THE SETO MARINE BIOLOGICAL LABORATORY 1996, 37(1-2): 167-191

ISSUE DATE:

1996-02-29

URL:

<http://hdl.handle.net/2433/176253>

RIGHT:

Four Species of the Genus *Grandidierella* (Crustacea : Amphipoda : Aoridae) from Osaka Bay and the Northern Part of the Kii Channel, Central Japan

HIROYUKI ARIYAMA

Osaka Prefectural Fisheries Experimental Station, Tanagawa, Misaki, Osaka 599-03, Japan

Abstract Four species of the genus *Grandidierella* were collected from estuaries and coastal area in Osaka Bay and the northern part of the Kii Channel, central Japan. *Grandidierella fasciata* sp. nov., *G. osakaensis* sp. nov. and *G. japonica* Stephensen, 1938 were from brackish area, *G. insulae* Myers, 1981 from sea area. These amphipods are described and validness of the three brackish species is examined by crossing experiments.

Key words : Amphipoda, Aoridae, *Grandidierella*, Osaka Bay, Kii Channel, crossing experiments

Introduction

The genus *Grandidierella* Coutière, 1904 contains 33 species to date. Prior to 1986, 31 species were recorded (Barnard & Karaman, 1991). After then two species, *G. taihuensis* Morino & Dai, 1990 and *G. nagadae* Myers, 1995, were described. So far in Japan only *Grandidierella japonica* Stephensen, 1938 represents this genus (Ishimaru, 1994). I have been investigating amphipod fauna of the coastal area and estuaries in Osaka Bay and the northern part of the Kii Channel since 1981. During this survey four *Grandidierella* species were collected, and two of them have turned to be new species. Present paper deals with descriptions of all these species and a result of crossing experiments among three brackish species. The dissected specimens including the type series are deposited in the Osaka Museum of Natural History (OMNH).

Descriptions

Grandidierella fasciata sp. nov.

(Japanese name : shima-dorosokoebi, new)

(Figs. 1-5)

Material examined. Holotype: male (OMNH-Ar-3840), 8.4 mm, intertidal zone at the mouth of the Higashi-kawa (Ochiai-gawa) River in Misaki, Osaka Prefecture (34°19'N, 135°07'E), brackish water, sandy mud bottom mixed with gravel, 20 Feb. 1992, collected by the author. Allotype: female (OMNH-Ar-3841), 6.5 mm, the same data as the holotype. Paratypes: 1 male (OMNH-Ar-3842), 7.4 mm and 1 female (OMNH-Ar-3843), 6.7 mm, 6 Feb. 1989; 1 male (OMNH-Ar-3844), 7.7 mm and 1 ovigerous female (OMNH-Ar-3845), 10.1 mm, 7 Jun. 1990; 1 male (OMNH-Ar-3846), 8.2 mm, 4 May 1991, the same place as the holotype, collected by the author. Besides the type series the specimens from following localities were examined (undissected): 68 individuals from pebble beach of Hakotsukuri in Han'n'an, Osaka Pref.; 10 from the mouth of the Tayama-gawa River in Han'n'an, Osaka Pref.; 28 from the mouth of the Oh-kawa River in Misaki, Osaka Pref.; hundreds from the mouth of the Higashi-kawa River in Misaki, Osaka Pref.; 3 from the estuary of the Ki-no-kawa River in Wakayama Pref.

Male (holotype)

Body (Fig. 1): Subcylindrical; rostrum indistinct; eyes oval, medium in size; pereon

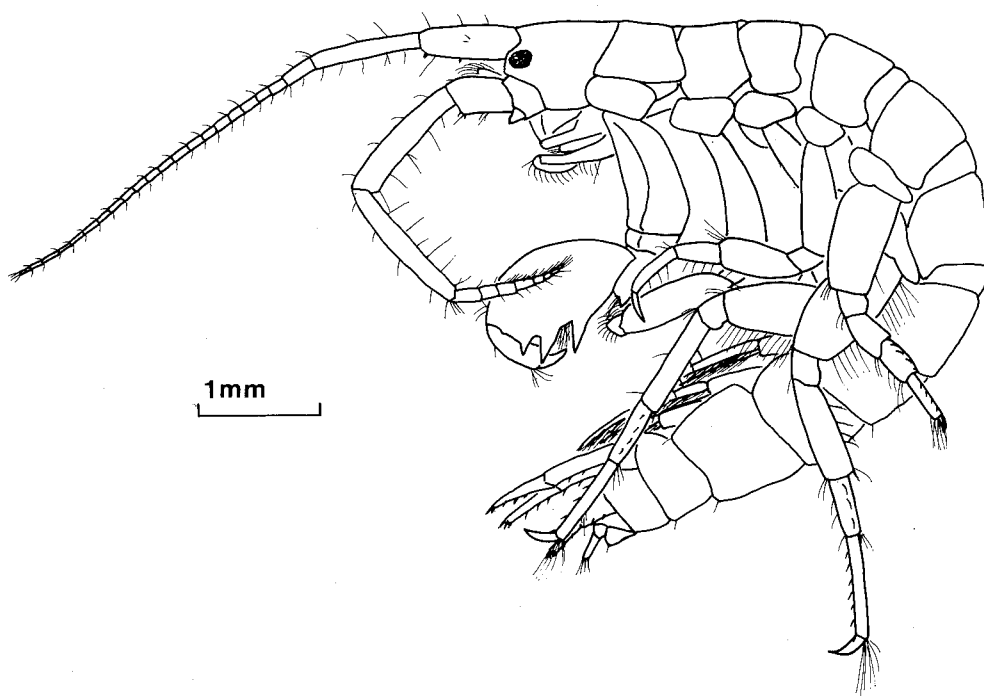


Fig. 1. *Grandidierella fasciata* sp. nov. Male (holotype).

segments lacking ventral process; epimeral plates 1-3 (Fig. 3-C), with a spine on ventroposterior corner, plate 2 with a plumose seta ventrally.

Antenna 1 (Fig. 3-A): Ratio of peduncular articles 1-3 2.8:3.1:1, article 1 robust, inner surfaces of articles 1-2 (Fig. 3-A1) with 3 and 2 spines, respectively; primary flagellum with 20 articles, 1.3 times as long as peduncle; accessory flagellum (Fig. 3-A2) uni-articulate, short.

Antenna 2 (Fig. 3-B): Peduncle stout, inner surfaces of articles 3-4 (Fig. 3-B1) with 5 and 4 spines, respectively, article 5 somewhat longer than article 4; flagellum short, with 7 articles, flagellar articles 4-7 (Fig. 3-B2) with 1, 1, 1, 2 curved spines, respectively.

Mouth parts: Upper lip (Fig. 4-E) subrounded ventrally without depression; lower lip (Fig. 4-F), ventral part of outer lobe covered with thin hairs, inner lobe incised; mandible (Fig. 4-D), palp article ratios 1:1.5:1.4; maxilla 1 (Fig. 4-C), outer plate with 10 apical spines, palp article 2 with 6 apical spines; maxilla 2 (Fig. 4-B), medial margin of inner plate with an oblique row of setae; maxilliped (Fig. 4-A), inner plate with 2 oblong spines, outer plate with 13 marginal spines, ratio of palp articles 1-4 1:1.7:1.1:0.6.

Coxal plates (Fig. 2): Plates 1-4 subrectangular; plates 5-7, posterior half shallower than anterior one; plate 1 largest.

Gnathopod 1 (Fig. 2-A): Large, complexly subchelate; article 2 wide, about 1.7 times as long as broad, posterior margin rounded with several setae; article 3 short; article 4 rectangular, posterodistal angle with an acute projection; article 5 subovoid, about 1.5 times as long as broad, posterior margin with three teeth, two large and one small; article 6, about half length of article 5, posterior margin expanded distally; dactyl medially weakly expanded.

Gnathopod 2 (Fig. 2-B): Slender, subchelate; article 2 elongate, slightly dilated distally; article 4 trapezoidal, distal margin setose; article 5 expanded medially, posterior margin

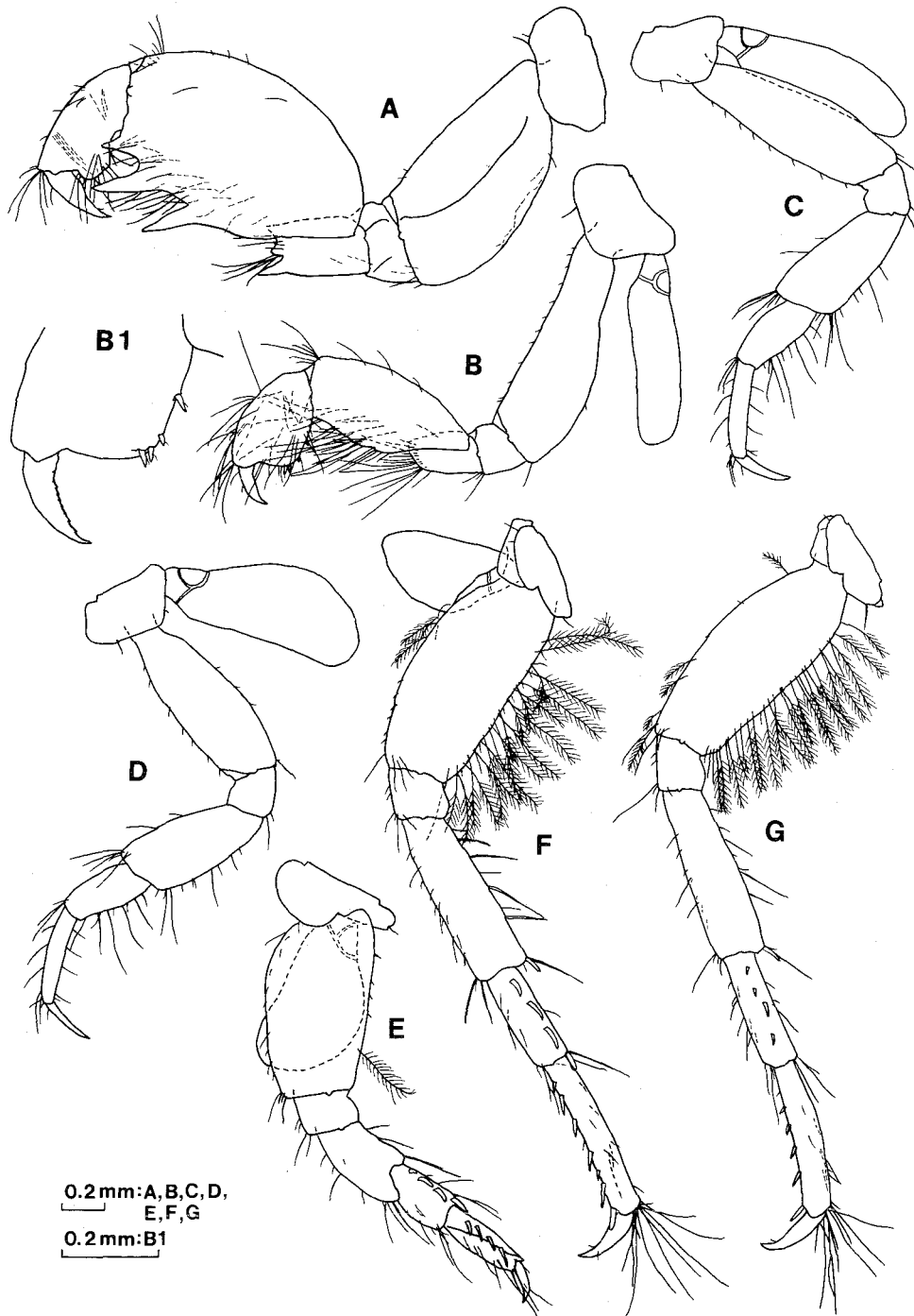


Fig. 2. *Grandidierella fasciata* sp. nov. Male (holotype): A, gnathopod 1; B, gnathopod 2; B1, palm and dactyl of gnathopod 2; C-G, pereopods 3-7.

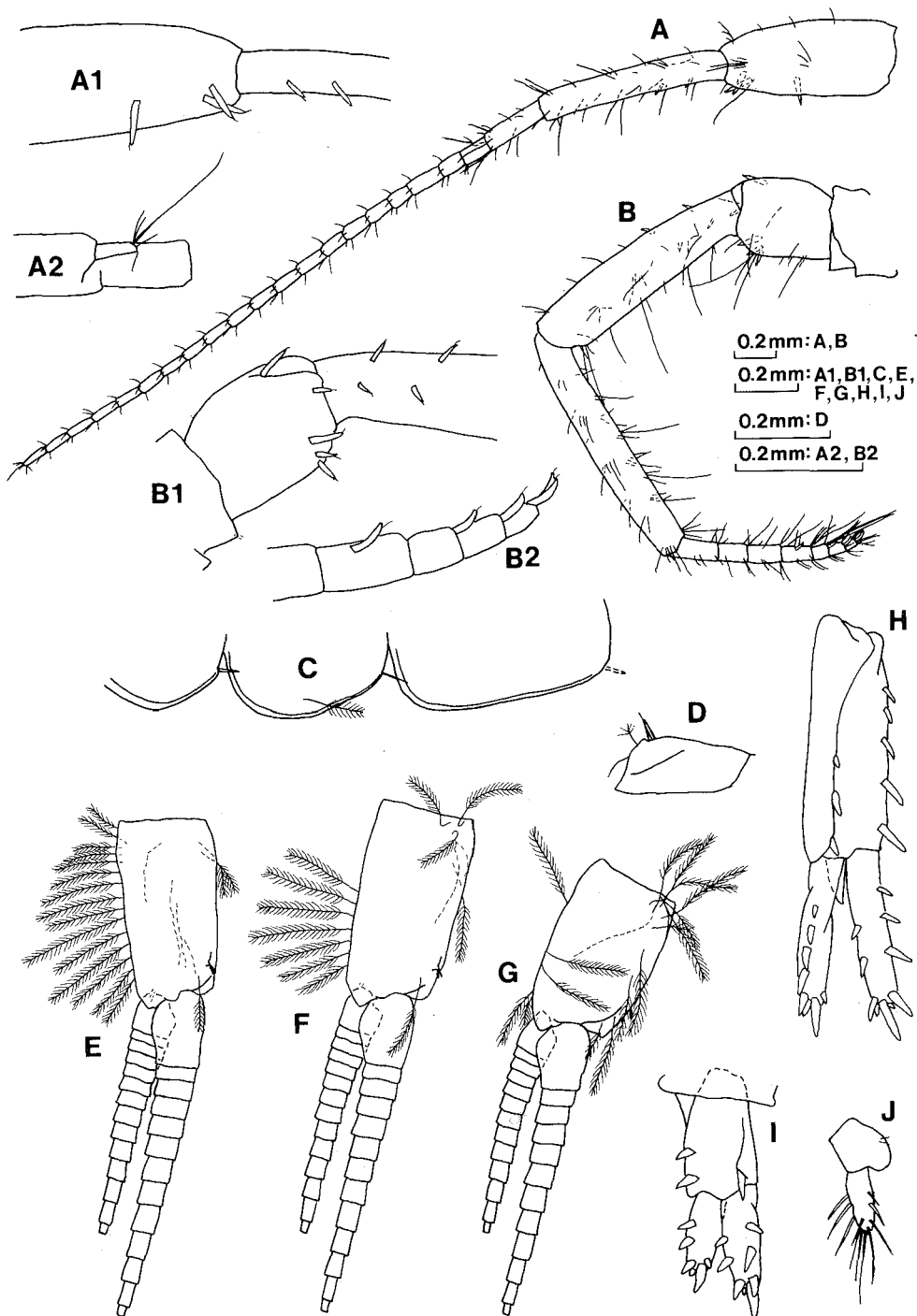


Fig. 3. *Grandidierella fasciata* sp. nov. Male (holotype): A, antenna 1; A1, peduncular articles 1-2 of antenna 1 (inner view); A2, accessory flagellum; B, antenna 2; B1, peduncular articles 3-4 of antenna 2 (inner view); B2, flagellum of antenna 2; C, epimeral plates 1-3; D, telson (lateral view); E-G, pleopods 1-3; H-J, uropods 1-3.

setose; article 6 ovoid, about two thirds length of article 5, palm almost transverse, defined by a pair of spines, posterior margin with 2 spines (Fig. 2-B1); dactyl unguiform, inner margin minutely serrate.

Pereopods 3-4 (Figs. 2-C,D) similar to each other, dactyl about 0.6 times as long as article 6; pereopod 5 (Fig. 2-E), article 2 posterodorsally produced, with a plumose seta posteriorly, articles 5-6 with a row of marginal spines; pereopods 6-7 (Figs. 2-F,G) similar to each other, elongate, 1.6 times as long as pereopod 5, article 2 with long plumose setae, several on anterior margin and numerous on posterior margin, posterodistal corner of article 4 with a spine, articles 5-6 with a row of marginal spines.

Pleopods 1-2 (Figs. 3-E,F) longer than pleopod 3 (Fig. 3-G); peduncles with long plumose setae and 2 coupling spines, outer ramus shorter than inner.

Uropods (Figs. 3-H,I,J): Peduncles of uropods 1-2 longer than respective rami, dorsal surfaces of peduncles and of both rami spinous, distal end of uropod 1 peduncle with a inter-ramal process; uropod 3, peduncle a little shorter than ramus, peduncle inner margin strongly expanded, ramus with tiny second article and 11 long setae.

Telson (Fig. 3-D): Rectangular in lateral view, with several setae on dorsolateral margins.

Female (allotype)

Similar to male except the following respects.

Gnathopod 1 (Figs. 4-I,I1): Smaller than that of male, subchelate; article 2 about 1.9 times as long as broad; article 4 trapezoidal without projection; article 5 subovoid, about 1.8 times as long as broad, posterior margin with setae and two spines; article 6 pyriform, a little shorter than article 5, palm oblique and defined by 3 spines, posterior margin with 2 spines; dactyl claw-like, inner margin minutely serrate.

Gnathopod 2 (Figs. 4-J,J1): Similar to that of male, but article 2 broadened medially and article 6 rectangular, about 0.8 times as long as article 5, palm transverse, defined by three spines.

Coloration in life

Eyes black; head, pereonites 4 and 7 dark brown, other pereonites and pleonites pale yellow, body patterned with stripes as a whole; antennae orange; other appendages whitish, article 6 of pereopods 3-4 with a red vermiform spot and article 6 of male gnathopod 2 (and sometimes male gnathopod 1) with a red small dot.

Remarks

This new species is very close to *Grandidierella dentimera* Myers, 1970 from Hawaii in male gnathopod 1 which has three teeth on article 5 and a projection on article 4. But *Grandidierella fasciata* differs from *G. dentimera* in the shape of article 6 of male gnathopod 1, shorter articles 5-6 of male gnathopod 2 and shorter inner lobe of lower lip. *Grandidierella fasciata* also resembles *G. bonnieroides* Stephensen, 1948, *G. lignorum* K.H. Barnard, 1935, *G. palama* J.L. Barnard, 1977 and *G. robusta* Ledoyer, 1982 in the presence of three teeth on article 5 of male gnathopod 1. However, this new species can be clearly distinguished from the latter 4 species by the presence of a projection on article 4 of male gnathopod 1.

Ecology

This species occurs in the middle-lower intertidal zone of the sandy mud bottom or under stones at river mouths. Females were observed brooding from March to June (July-January were not examined).

Distribution

From Hakotsukuri in Han'nan, Osaka Prefecture to the estuary of the Ki-no-kawa River

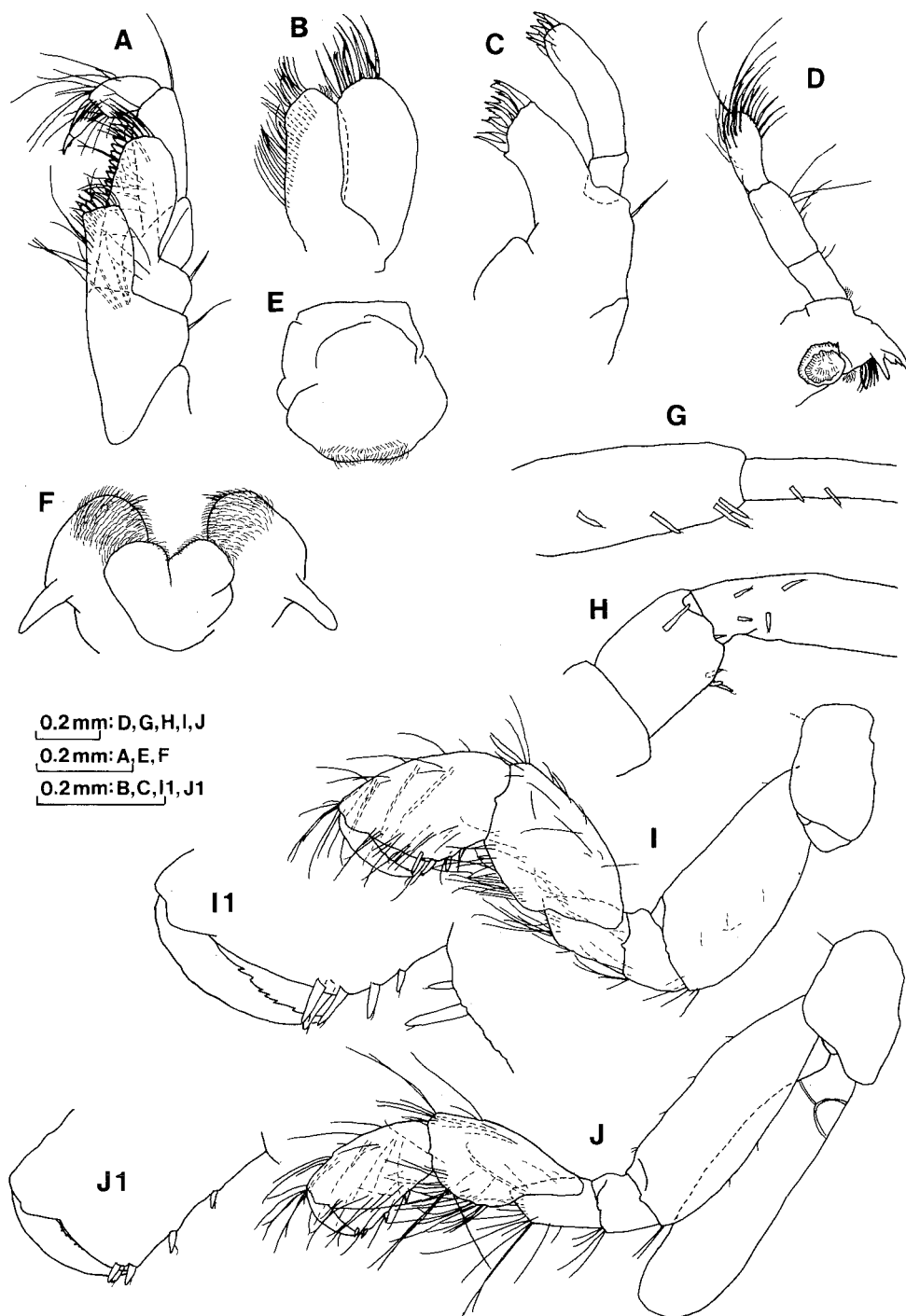


Fig. 4. *Grandidierella fasciata* sp. nov. Male (holotype): A, maxilliped; B, maxilla 2; C, maxilla 1; D, mandible; E, upper lip; F, lower lip. Female (allotype): G, peduncular articles 1-2 of antenna 1 (inner view); H, peduncular articles 3-4 of antenna 2 (inner view); I, gnathopod 1; J, gnathopod 2 (oostegite omitted); J1, palm and dactyl of gnathopod 2.

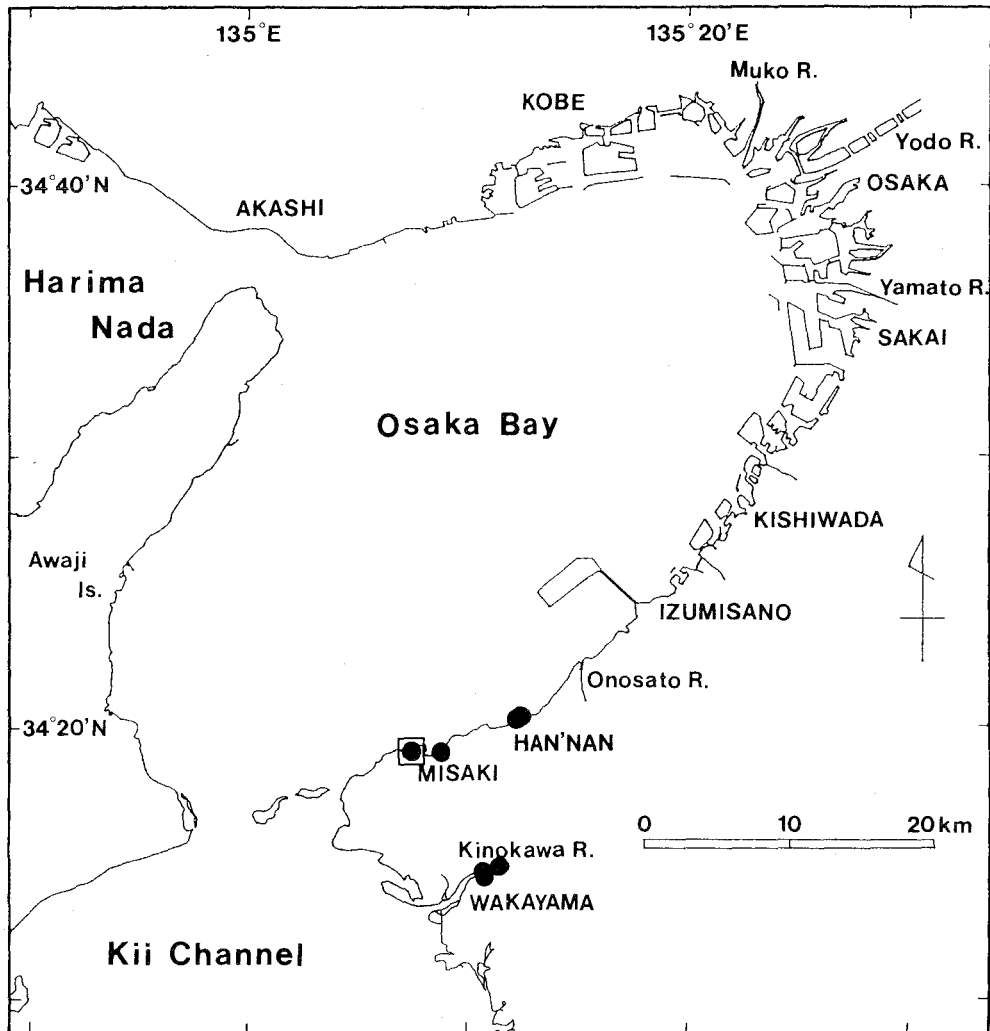


Fig. 5. Distribution of *Grandidierella fasciata* sp. nov. Square shows the type locality.

in Wakayama Prefecture (Fig. 5).

***Grandidierella osakaensis* sp. nov.**

(Japanese name: ohsaka-dorosokoebi, new)

(Figs. 6-10)

Material examined. Holotype: male (OMNH-Ar-3855), 6.9 mm, intertidal zone at the mouth of the Yodo-gawa River in Osaka (34°41'N, 135°25'E), brackish water, the sandy mud bottom mixed with gravel, 11 May 1991, collected by the author. Allotype: female (OMNH-Ar-3856), 7.1 mm, the same data as the holotype. Paratypes: 1 male (OMNH-Ar-3857), 6.1 mm, the same data as the holotype; 1 male (OMNH-Ar-3858), 7.5 mm, and 1 female (OMNH-Ar-3859), 6.9 mm, intertidal zone at the mouth of the Higashi-kawa River in Misaki, Osaka Pref., brackish water, the sandy mud bottom mixed with gravel, 20 Feb. 1992, collected by the author. Besides the type series the

specimens from following localities were examined: 175 individuals from the mouth of the Yodo-gawa River in Osaka; 49 from the mouth of the Oh-kawa River in Misaki, Osaka Pref., 102 from the mouth of the Higashi-kawa River in Misaki, Osaka Pref.

Male (holotype)

Body (Fig. 6): Subcylindrical; rostrum indistinct; eyes oval, small; inferior antennal sinus deep; pereon segments lacking ventral process; epimeral plates 1-3 (Fig. 8-C), with a spine on posteroventral corner, plate 2 with several setae ventrally.

Antenna 1 (Fig. 8-A): Ratio of peduncular articles 1-3 2.3:2.9:1, ventral surfaces of articles 1-2 with 3 and 2 spines, respectively (Fig. 8-A1); primary flagellum with 21 articles, almost as long as peduncle; accessory flagellum (Fig. 8-A2) uni-articulate, short.

Antenna 2 (Fig. 8-B): Peduncle conspicuously robust, inner surfaces of articles 3-4 (Fig. 8-B1) with 4 and 2 spines, respectively, article 5 as long as article 4; flagellum short, with 6 articles, articles 2-6 (Fig. 8-B2) with 1, 1, 1, 1, 2 curved spines, respectively.

Mouth parts: Upper lip (Fig. 9-E) subrounded, with a projection dorsally; lower lip (Fig. 9-F), ventral part of outer lobe covered with thin hairs, inner lobe incised; mandible (Fig. 9-D), palp article ratios 1:1.4:1.5; maxilla 1 (Fig. 9-C), outer plate with 8 apical spines (probably a few spines were lost), palp article 2 with 6 apical spines; maxilla 2 (Fig. 9-B), medial margin of inner plate with a row of short setae; maxilliped (Fig. 9-A), inner plate with 4 oblong spines, outer plate with 7 marginal spines, ratio of palp articles 1-4 1:1.7:1.1:0.7.

Coxal plates (Fig. 7): Plates 1-4 subrectangular, plates 5-6 posterior half shallower than anterior one, plate 7 triangular, short; plate 5 largest.

Gnathopod 1 (Fig. 7-A): Large, complexly subchelate; article 2 wide, about 1.7 times as long as broad, posterior margin rounded with several setae; article 3 short, produced posterodistally; article 4 longish rectangular, posterodistal end with an acute projection; article 5 subovoid, about 1.6 times as long as broad, posterior margin with three teeth, two large and one small; article 6 rectangular, about half length of article 5, posterior margin

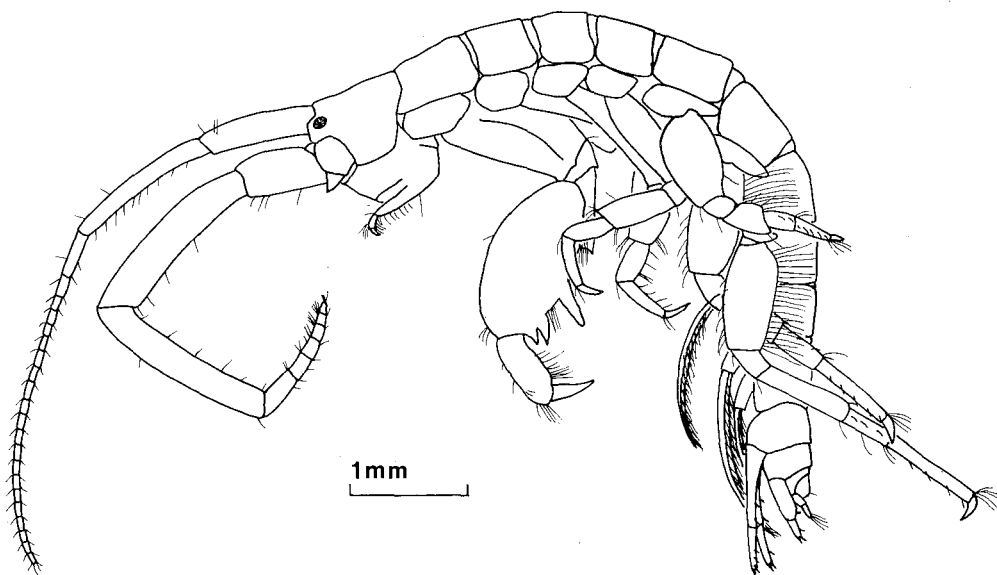


Fig. 6. *Grandidierella osakaensis* sp. nov. Male (holotype).

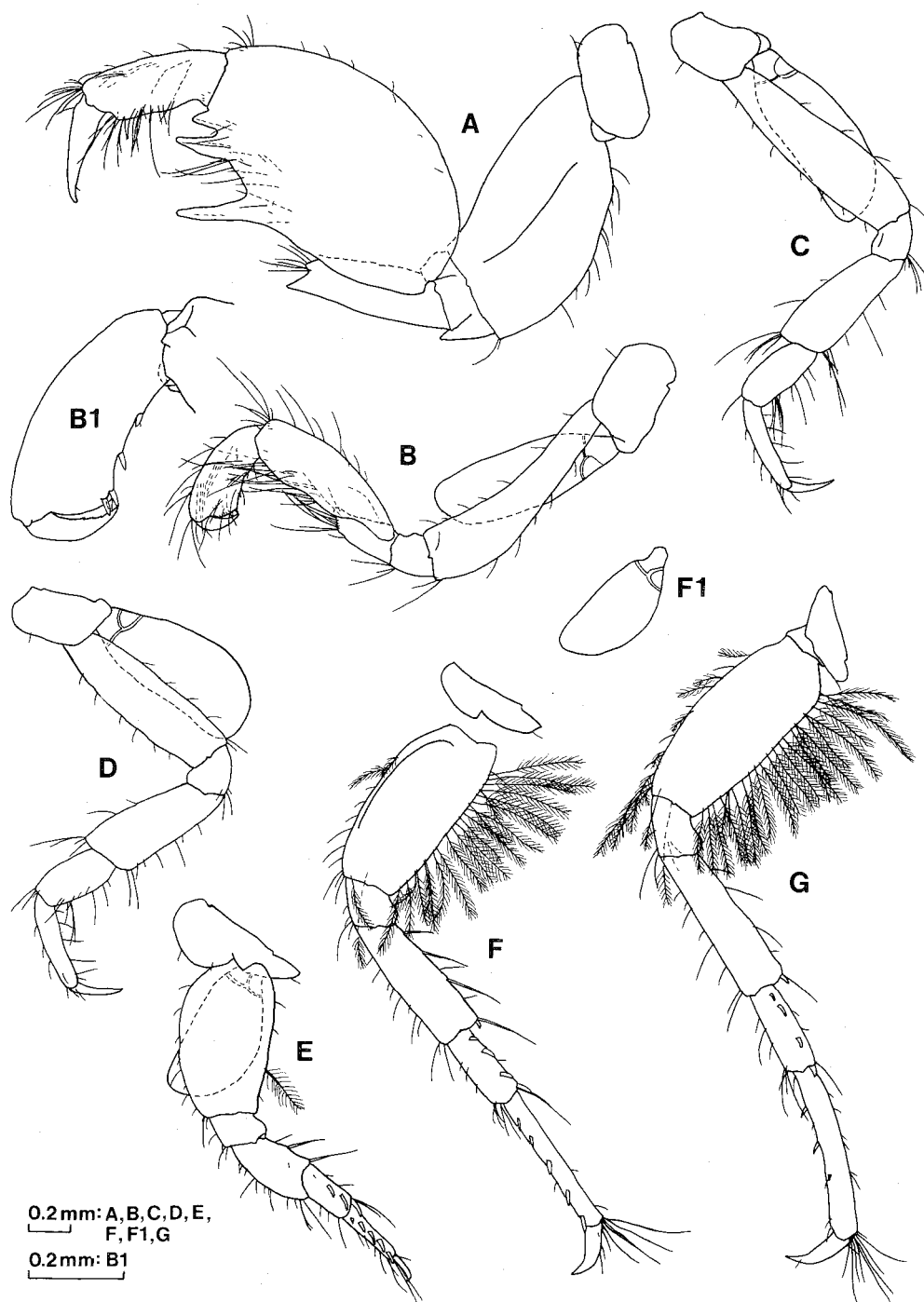


Fig. 7. *Grandidierella osakaensis* sp. nov. Male (holotype): A, gnathopod 1; B, gnathopod 2; B1, article 6 and dactyl of gnathopod 2; C-G, pereopods 3-7; F1, gill of pereopod 6.

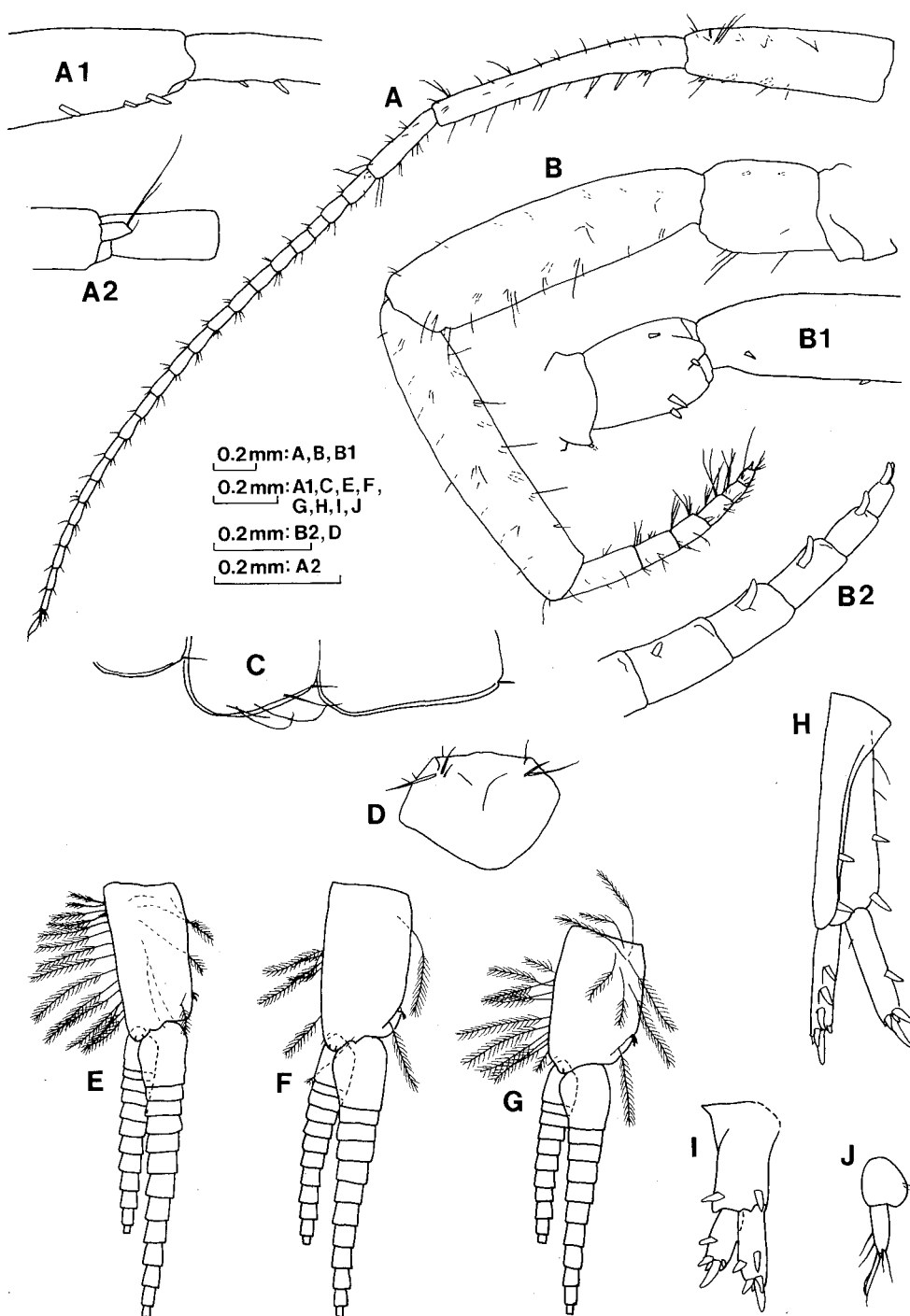


Fig. 8. *Grandidierella osakaensis* sp. nov. Male (holotype): A, antenna 1; A1, peduncular articles 1-2 of antenna 1 (inner view); A2, accessory flagellum; B, antenna 2; B1, peduncular articles 3-4 of antenna 2 (inner view); B2, flagellum of antenna 2; C, epimeral plates 1-3; D, telson (dorsal view); E-G, pleopods 1-3; H-J, uropods 1-3.

nearly straight; dactyl somewhat elongate, slightly expanded medially.

Gnathopod 2 (Fig. 7-B): Slender, subchelate; article 2 much elongate, broadened distally; article 4 trapezoidal, with long setae on distal margin; article 5 elongate, posterior margin setose; article 6 long, curved posteriorly, about 0.7 times as long as article 5, palm almost transverse, defined by 3 spines, posterior margin with 2 spines (Fig. 7-B1); dactyl unguiform, inner margin minutely serrate.

Pereopods 3-4 (Figs. 7-C,D) similar to each other, dactyl about half length of article 6; pereopod 5 (Fig. 7-E), article 2 posterodorsally produced, with a plumose seta posteriorly, articles 5-6 with a row of marginal spines; pereopods 6-7 (Figs. 7-F,G) similar to each other, elongate, 1.5-1.7 times as long as pereopod 5, article 2 with long plumose setae, several on anterior margin and numerous on posterior margin, posterodistal corner of article 4 with a spine, articles 5-6 with a row of marginal spines.

Pleopods 1-2 (Figs. 8-E,F) longer than pleopod 3 (Fig. 8-G); peduncles with long plumose setae and 2 coupling spines, outer ramus shorter than inner.

Uropods (Figs. 8-H,I,J): Peduncles of uropods 1-2 longer than respective rami, dorsal surfaces of peduncles and of both rami spinous, distal end of uropod 1 peduncle without inter-ramal process; uropod 3, peduncle a little shorter than ramus, peduncle inner margin expanded, ramus with tiny second article and 7 long setae.

Telson (Fig. 8-D): Subtrapezoidal in dorsal view, with several setae on posterior part.

Female (allotype)

Similar to male except the following respects.

Antennae: Inner surface of antenna 1 peduncle (Fig. 9-I), article 1 with 6 spines and article 2 without spine; inner surface of antenna 2 peduncle (Fig. 9-H), articles 3-5 with 4, 7, 2 spines, respectively, antenna 2 flagellum with 8 articles, articles 4-8 (Fig. 9-G) with 2 curved spines.

Gnathopod 1 (Figs. 9-J,J1): Smaller than that of male, subchelate; article 2 about 1.8 times as long as broad; article 4 roundish trapezoidal without projection; article 5 subovoid, about 1.5 times as long as broad, posterior margin with setae and a spine; article 6 ovoid, slightly shorter than article 5, palm oblique, defined by 3 spines, posterior margin with a spine; dactyl claw-like, inner margin minutely serrate.

Gnathopod 2 (Figs. 9-K,K1): Slender, subchelate; article 2 broader medially; article 4 trapezoidal, distal margin setose; article 5 expanded medially, posterior margin setose; article 6 rectangular, about 0.8 times as long as article 5, palm transverse, defined by a pair of spines, posterior margin with 2 spines; dactyl unguiform, inner margin minutely serrate.

Coloration in life

Eyes black; head, pereonites and pleonites brown; antennae pale red; article 6 of male gnathopod 1 pale red with a red small dot; other appendages whitish, article 6 of male gnathopod 2 with a red small dot and article 6 of pereopods 3-4 with a red vermiform spot.

Remarks

This new species is very closely related to *Grandidierella fasciata* and *G. dentimera* Myers, 1970 in the shape of the male gnathopod 1, which has a projection on article 4 and three teeth on article 5. But several clear differences are present between *G. osakaensis* and *G. fasciata* (Table 1). *Grandidierella osakaensis* can be also distinguished from *G. dentimera* by robust antenna 2, straight posterior margin of article 6 of male gnathopod 1, and ovoid article 6 of female gnathopod 1.

Ecology

This species occurs in the sandy mud bottom or under stones of middle-lower intertidal zone at river mouths. Females were observed brooding in April and May (only February,

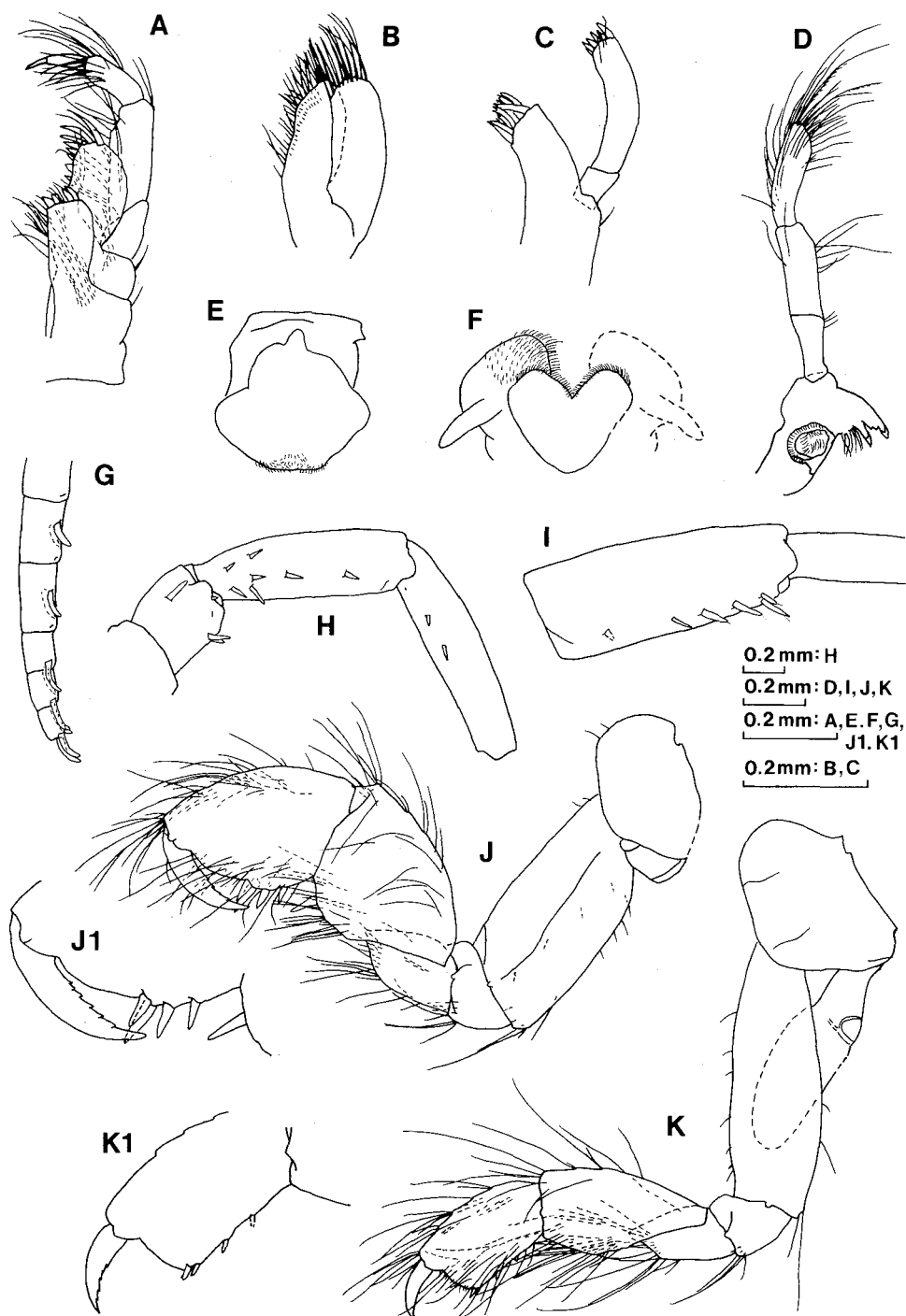
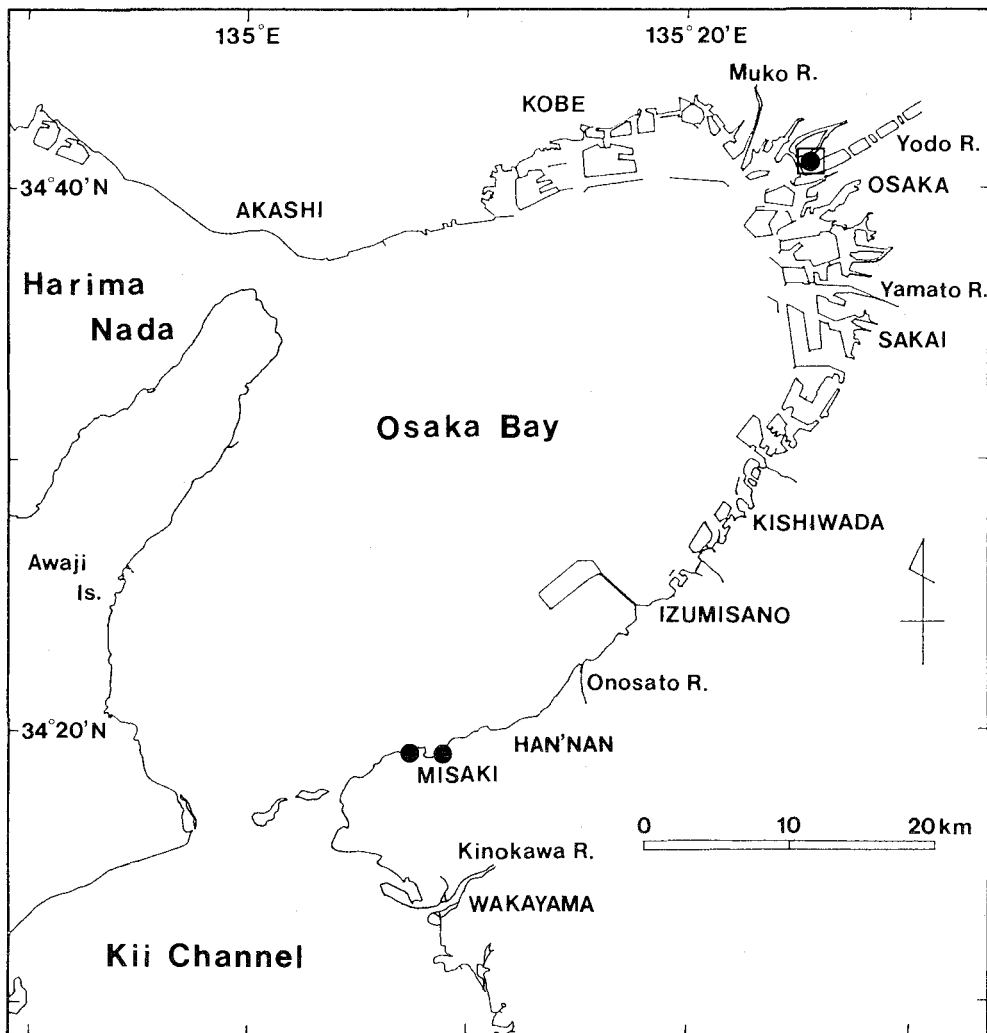


Fig. 9. *Grandidierella osakaensis* sp. nov. Male (holotype): A, maxilliped; B, maxilla 2; C, maxilla 1; D, mandible; E, upper lip; F, lower lip. Female (allotype): G, flagellum of antenna 2; H, peduncular articles 3-5 of antenna 2 (inner view); I, peduncular articles 1-2 of antenna 1 (inner view); J, gnathopod 1; J1, palm and dactyl of gnathopod 1; K, gnathopod 2 (oostegite omitted); K1, palm and dactyl of gnathopod 2.

Table 1. Differences between *Grandidierella fasciata* sp. nov. and *G. osakaensis* sp. nov.

Characters	<i>G. fasciata</i>	<i>G. osakaensis</i>
Antenna 2	normal	robust
Projection of upper lip	absent	present
Posterior margin of male gnathopod 1 article 6	expanded distally	straight
Article 6 of male gnathopod 2	short	long
Inter-ramal process of uropod 1	present	absent
Spines on peduncular article 2 of female antenna 1	present	absent
Spines on peduncular article 5 of female antenna 2	absent	present

Fig. 10. Distribution of *Grandidierella osakaensis* sp. nov. Square shows the type locality.

April and May examined).

Distribution

The mouth of the Yodo-gawa River in Osaka, the mouth of the Oh-kawa River in Misaki, Osaka Prefecture and the mouth of the Higashi-kawa River in Misaki, Osaka Prefecture (Fig. 10).

Grandidierella insulae Myers, 1981

(Japanese name : akahige-dorosokoebi, new)

(Figs. 11-15)

Grandidierella insulae Myers, 1981, pp. 220-222, fig. 5.

Material examined. Male(1) (OMNH-Ar-3847), 9.0 mm, intertidal zone of Nagasaki coast in Misaki, Osaka Pref., under stones, 17 May 1992, collected by the author ; male(2) (OMNH-Ar-3848), 7.6 mm, male(3) (OMNH-Ar-3849), 8.4 mm, female(1) (OMNH-Ar-3850), 8.8 mm and female(2) (OMNH-Ar-3851), 8.8 mm, intertidal zone of Toyokuni-zaki coast in Misaki, Osaka Pref., in muddy sand under stones, 22 Apr. 1989, collected by the author. Besides these materials the specimens from following localities were examined : 7 individuals from pebble beach outside of the mouth of the Onosato-gawa River in Han'nan, Osaka Pref. ; 3 from pebble beach of Hakotsukuri in Han'nan, Osaka Pref. ; 18 from Nagasaki coast in Misaki, Osaka Pref. ; 2 from

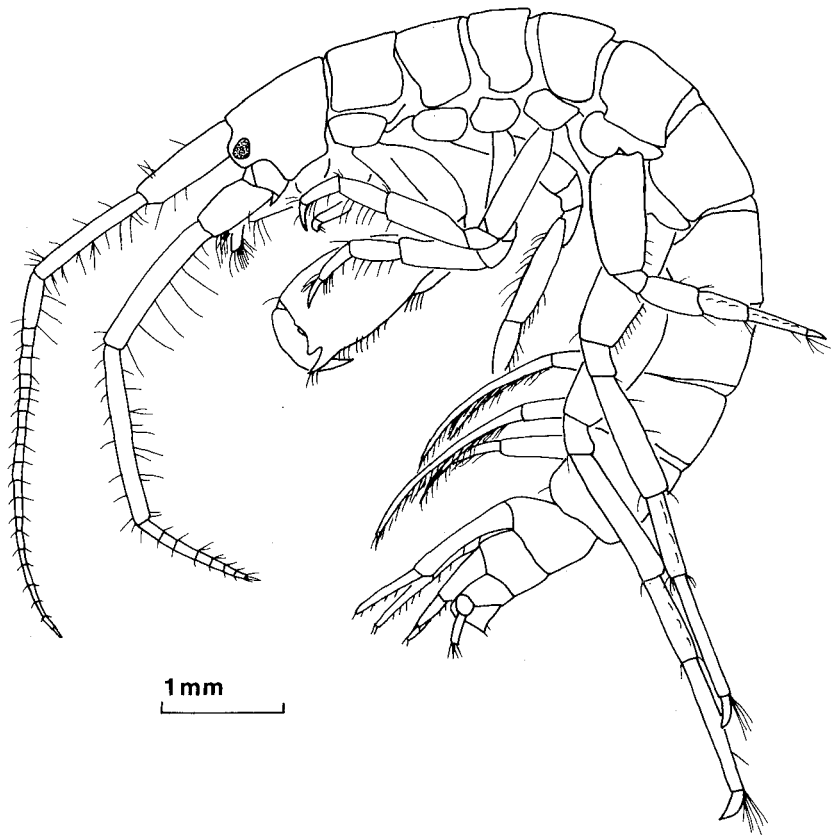


Fig. 11. *Grandidierella insulae* Myers. Male(1).

the mouth of the Oh-kawa River in Misaki, Osaka Pref.; 1 from pebble beach outside of the mouth of the Higashi-kawa River in Misaki, Osaka Pref.; 47 from Toyokuni-zaki coast in Misaki, Osaka Pref.; 9 from Ebisu-zaki coast in Wakayama Pref.; 1 from Tagura-zaki coast in Wakayama Pref.

Male (1)

Body (Fig. 11): Subcylindrical, somewhat flattened laterally; rostrum indistinct; eyes ovoid, medium in size; pereon segments lacking ventral process; epimeral plates 1-3 (Fig. 13-C) with a spine on ventroposterior corner.

Antenna 1 (Fig. 13-A): Peduncle elongate, ratio of articles 1-3 2.2:2.5:1, article 1, with a stout spine on ventral surface and 5 spines on inner surface (Fig. 13-A1), article 2 without spines; primary flagellum with 20 articles, 1.1 times as long as peduncle; accessory flagellum (Fig. 13-A2) uni-articulate, short.

Antenna 2 (Fig. 13-B): Peduncle elongate, articles 3-4 spinous on inner and ventral surfaces, article 3 with 6 spines, article 4 with 10 spines (Fig. 13-B1), article 5 somewhat longer than article 4; flagellum short with 7 articles, articles 3-7 (Fig. 13-B2) with 1, 1, 1, 2, 2 curved spines, respectively.

Mouth parts: Upper lip (Fig. 14-E) lozenge-shaped, weakly concaved mid-ventrally; lower lip (Fig. 14-F) somewhat widened, ventral part of outer lobe with many thin hairs and a few setae, inner lobe expanded laterally; mandible (Fig. 14-D), palp article ratios 1:1.3:1.6; maxilla 1 (Fig. 14-C), outer plate with 9 apical spines, palp article 2 with 7 apical spines; maxilla 2 (Fig. 14-B), medial margin of inner plate with a row of setae; maxilliped (Fig. 14-A), inner plate with 4 semioblong spines, outer plate with 14 marginal spines, ratio of palp articles 1-4 1:1.9:1.4:0.7.

Coxal plates (Fig. 12): Plates 1-4 roundish rectangular; plate 5 largest, posterior half shallower than anterior one; plates 6-7 short with plumose setae anteriorly.

Gnathopod 1 (Fig. 12-A): Large, complexly subchelate; article 2 wide, about 1.8 times as long as broad, anterior margin straight, posterior margin rounded with a few setae; article 3 short; article 4 lanceolate; article 5 about 1.5 times as long as broad, posterodistal corner with 2 teeth, posterior one large; article 6, about half as long as article 5, curved posteriorly with roundish bulge on posterodistal corner, anterodistal corner with a small projection; dactyl ensiform.

Gnathopod 2 (Fig. 12-B): Slender, subchelate; article 2 elongate, curved anteriorly, broadened distally; article 4 longish trapezoidal, distal margin setose; article 5 markedly elongate, posterior margin setose; article 6 rectangular, 0.55 times as long as article 5, palm almost transverse, defined by 3 spines, posterior margin with 2 spines (Fig. 12-B1); dactyl unguiform.

Pereopods 3-4 (Figs. 12-C,D) similar to each other, dactyl about 0.7 times as long as article 6; pereopod 5 (Fig. 12-E), article 2 somewhat elongate, posterodorsally produced, with several setae posteriorly, articles 5-6 with a row of marginal spines; pereopods 6-7 (Figs. 12-F,G) similar to each other, elongate, 1.6-1.7 times as long as pereopod 5, article 2 with rows of short spines on anterior and posterior margins and with several short setae on distal part of posterior margin, postero- and anterodistal corners of article 4 with a spine, articles 5-6 with a row of marginal spines.

Pleopods 1-2 (Figs. 13-E,F) a little longer than pleopod 3 (Fig. 13-G); peduncles with several plumose setae and 2 coupling spines, outer ramus shorter than inner.

Uropods (Figs. 13-H,I,J): Peduncle of uropod 1 longer than rami, dorsal surfaces of peduncle and of both rami spinous, distal end of peduncle with a inter-ramal process; uropod 2, peduncle as long as rami, margins of peduncle and rami spinous, inner ramus longer than outer; uropod 3, peduncle shorter than ramus, peduncle inner margin strongly expanded,

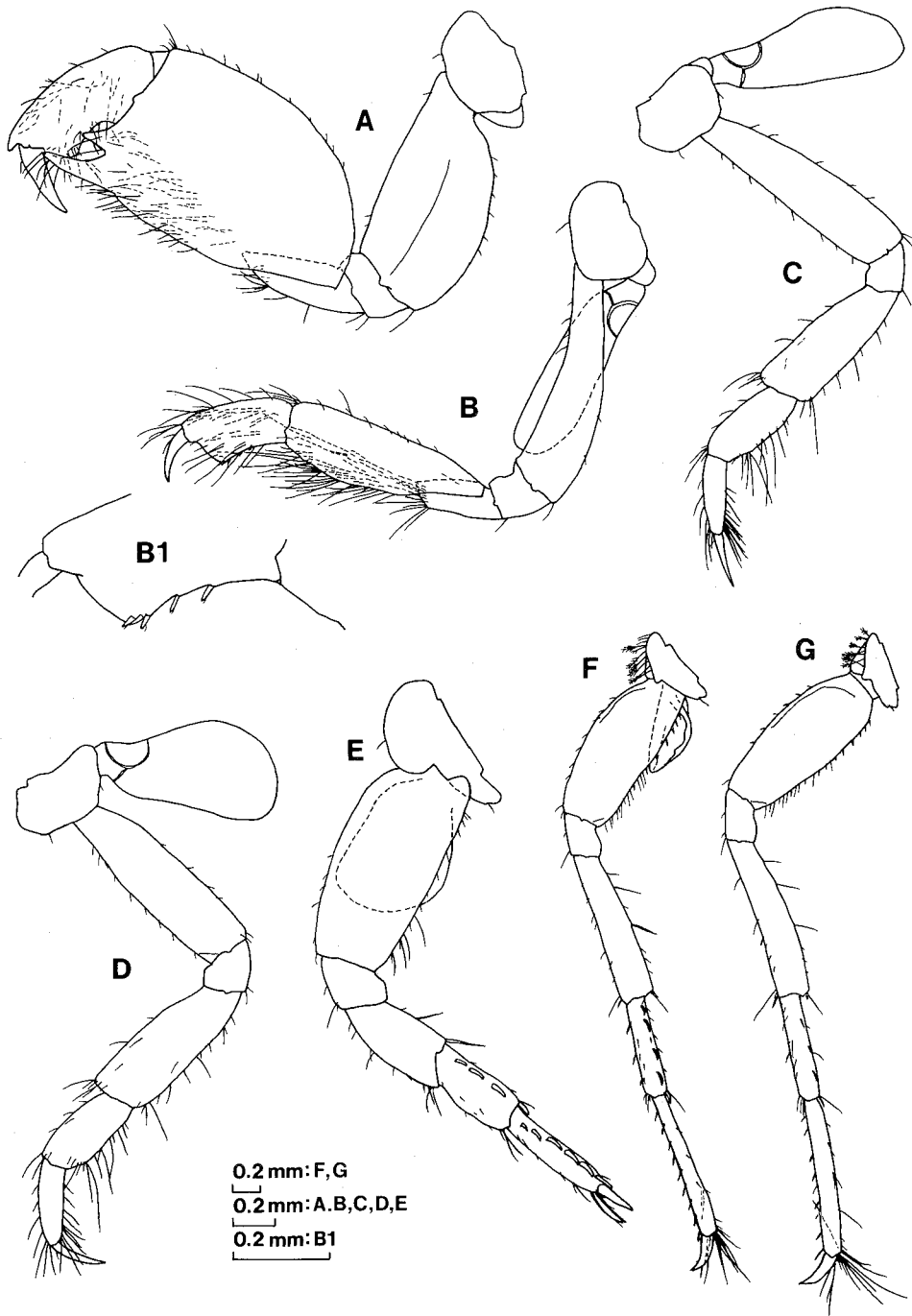


Fig. 12. *Grandidierella insulae* Myers. Male(1): A, gnathopod 1; B, gnathopod 2; B1, palm of gnathopod 2; C-G, pereopods 3-7.

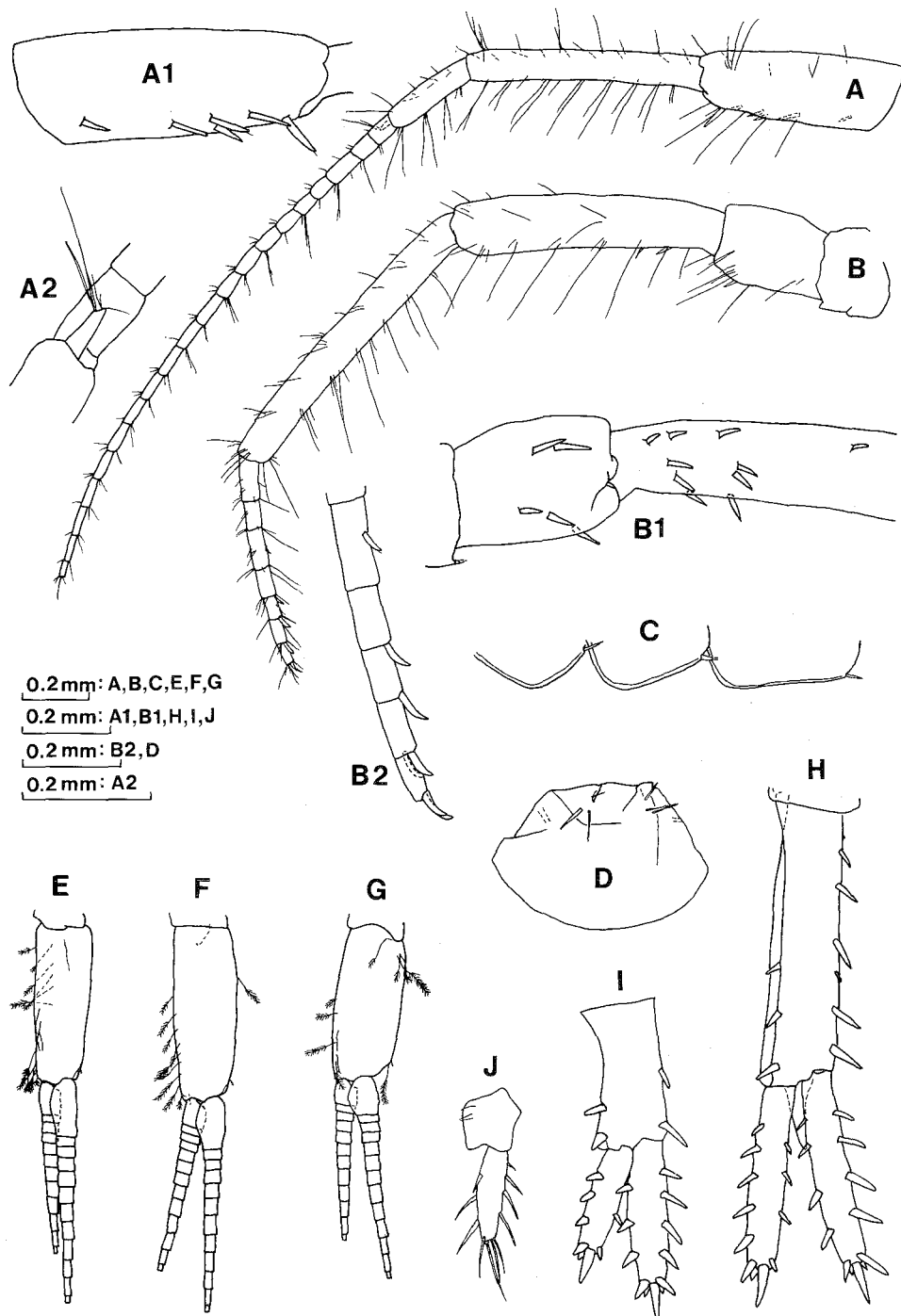


Fig. 13. *Grandidierella insulae* Myers. Male(1): A, antenna 1; A1, peduncular article 1 of antenna 1 (inner view); A2, accessory flagellum; B, antenna 2; B1, peduncular articles 3-4 of antenna 2 (inner view); B2, flagellum of antenna 2; C, epimeral plates 1-3; D, telson (dorsal view); E-G, pleopods 1-3; H-J, uropods 1-3.

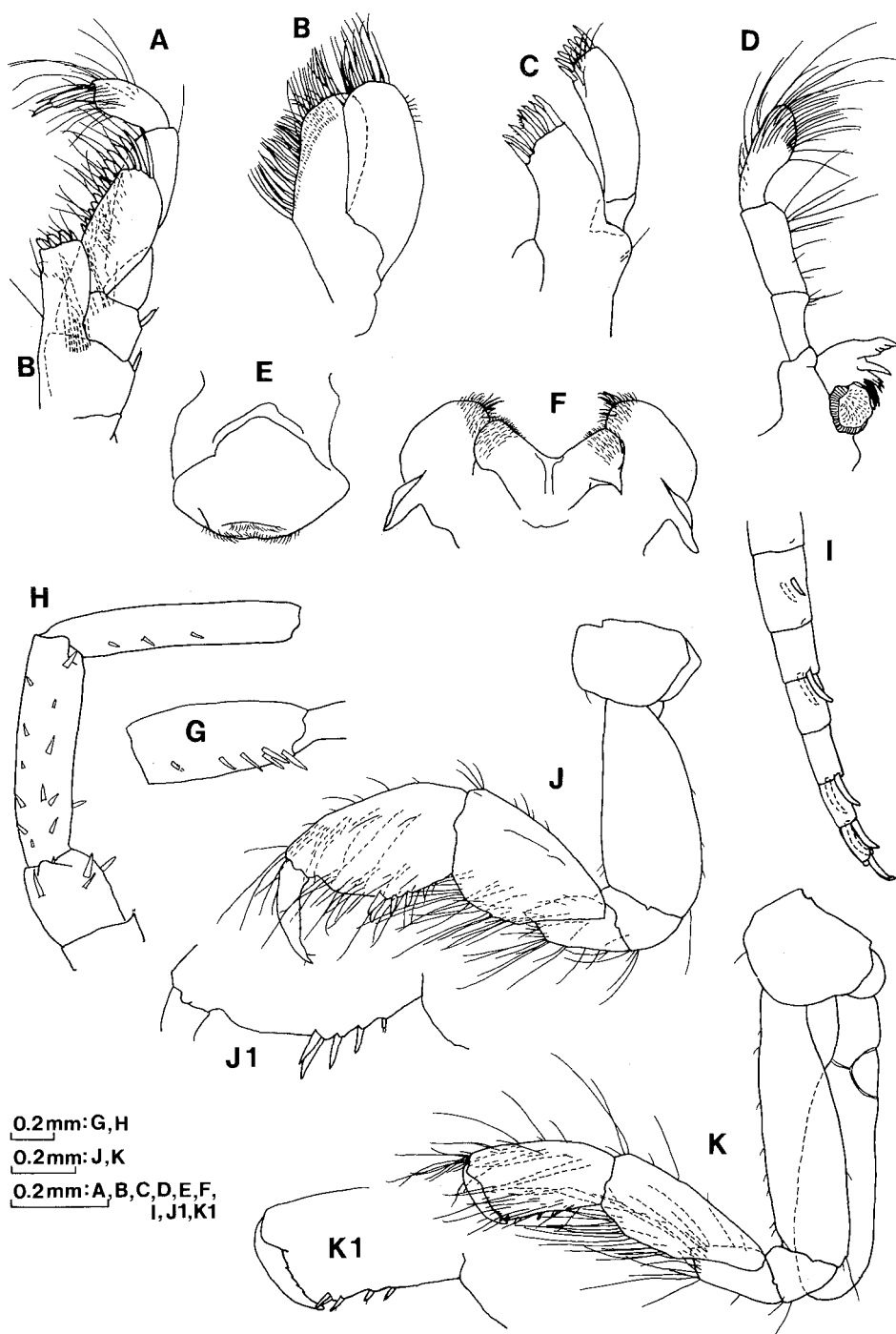


Fig. 14. *Grandidierella insulae* Myers. Male(1): A, maxilliped; B, maxilla 2; C, maxilla 1; D, mandible; E, upper lip; F, lower lip. Female(1): G, peduncular article 1 of antenna 1 (inner view); H, peduncular articles 3-5 of antenna 2 (inner view); I, flagellum of antenna 2; J, gnathopod 1; J1, palm of gnathopod 1; K, gnathopod 2 (oostegite omitted); K1, palm and dactyl of gnathopod 2.

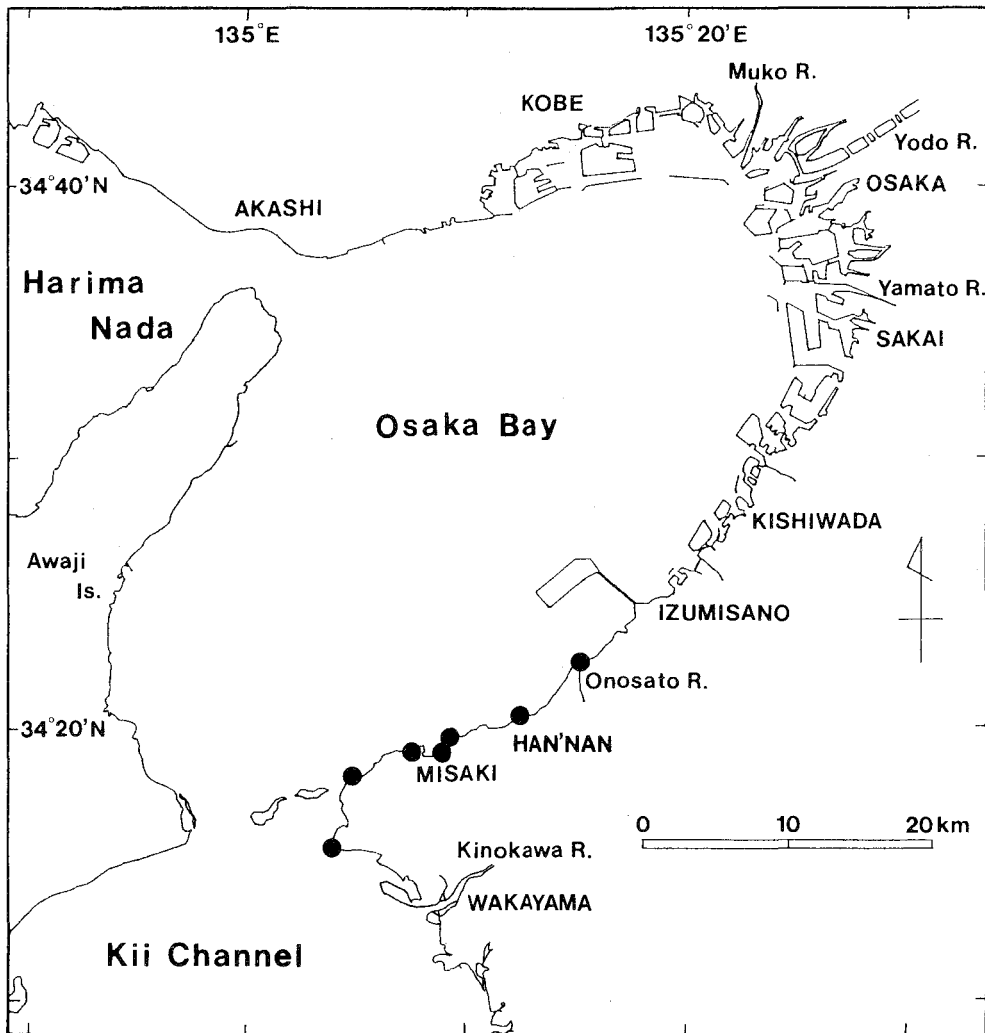


Fig. 15. Distribution of *Grandidierella insulae* Myers.

ramus with tiny second article and 11 long setae.

Telson (Fig. 13-D): Subtrapezoidal in dorsal view, with several setae on posterior part.

Female (1)

Similar to male except the following respects.

Antenna 2: Peduncular articles 3-5 (Fig. 14-H) spinous on inner and ventral surfaces, article 3 with 5 spines, article 4 with 13 spines, article 5 with 3 spines; flagellum articles 2-7 (Fig. 14-I) with 2, 2, 0, 2, 2, 2 curved spines, respectively.

Gnathopod 1 (Figs. 14-J, J1): Smaller than that of male, subchelate; article 2 about 1.9 times as long as broad; article 4 roundish trapezoidal; article 5 pyriform, about 1.7 times as long as broad, posterior margin setose; article 6 pyriform, a little longer than article 5, palm oblique, defined by 2 spines, posterior margin with 3 spines; dactyl claw-like, inner margin minutely serrate.

Gnathopod 2 (Figs. 14-K, K1): Somewhat slender, subchelate; article 2 broadened medially; article 4 trapezoidal, distal margin setose; article 5 a little elongate, posterior margin setose; article 6 rectangular, 0.8 times as long as article 5.

Coloration in life

Eyes black; head, pereonites and pleonites brown; antennae mostly bright red; other appendages pale orange, article 6 of pereopods 3-4 with a red vermiform spot.

Remarks

Most of the morphological characters of the present specimens well agreed with the descriptions and figures of *Grandidierella insulae* Myers, 1981 from Australia, except for the number of spines on article 6 of female gnathopod 1. This species is closely related to *Grandidierella koa* J.L. Barnard, 1977 from Hawaii in the shape of gnathopods 1-2. However *Grandidierella koa* differs from *G. insulae* in the following characters: *G. koa* has (1) slender article 2 of male gnathopod 1, (2) nipple on anterior apex of article 2 of male gnathopod 2, (3) long plumose setae on article 2 of pereopods 6-7, and (4) shorter peduncle of pleopods.

Grandidierella insulae also resembles *G. bispinosa* Schellenberg, 1938, *G. elongata* (Chevreux), 1925, *G. mahafalensis* Coutière, 1904, *G. makena* (J.L. Barnard, 1970) and *G. nagadae* Myers, 1995 in having 2 teeth on article 5 of male gnathopod 1. But *Grandidierella insulae* can be distinguished from the latter 5 species by the presence of a small projection on the anterodistal corner of article 6 of male gnathopod 1.

Ecology

This species occurs in muddy sand under stones or rocks in the middle-lower intertidal zone. Marine (salinity: 30-33), rarely semi-brackish. Females were observed brooding from April to July (March and August not examined).

Distribution

From the mouth of the Onosato-gawa River in Han'n'an, Osaka Prefecture to Tagurazaki coast in Wakayama Prefecture (Fig. 15); Lord Howe Island in Australia (Myers, 1977).

***Grandidierella japonica* Stephensen, 1938**

(Japanese name: nihon-dorosokoebi)

(Figs. 16-18)

Grandidierella japonica Stephensen, 1938, pp. 179-184, figs. 1-2; Nagata, 1960, p. 179, pl. 17, fig. 103; Nagata, 1965, pp. 320-321, fig. 41; Kudrjaschov & Tzvetkova, 1975, p. 1309; Chapman & Dorman, 1975, pp. 104-108, figs. 1-5; Myers, 1981, pp. 218-219, fig. 4; Hirayama, 1984, pp. 15-17, figs. 53-56.

Material examined. Male(1) (OMNH-Ar-3852), 9.0 mm, intertidal zone at the mouth of the Higashi-kawa River in Misaki, Osaka Pref., brackish water, mud bottom, 30 Mar. 1990, collected by the author; male(2) (OMNH-Ar-3853), 8.0 mm, the same place, 11 Apr. 1990, collected by the author; ovigerous female (OMNH-Ar-3854), 9.5 mm, the same data as male(1). Besides these materials the specimens from following localities were examined: 250 individuals from the estuary of the Yodo-gawa River in Osaka (from the river mouth to Nagara); 5 from the mouth of the Yamato-gawa River in Sakai, Osaka Pref.; 1 from Ishizu fishery port in Sakai, Osaka Pref.; 12 from the mouth of the Kasii-gawa River in Sen'n'an, Osaka Pref.; 13 from Tarui in Sen'n'an, Osaka Pref.; 5 from the mouth of the Onosato-gawa River in Han'n'an, Osaka Pref.; 51 from pebble beach of Hakotsukuri in Han'n'an, Osaka Pref.; 46 from the mouth of the Tayama-gawa River in Han'n'an, Osaka Pref.; 2 from the mouth of the Oh-kawa River in Misaki, Osaka Pref.; 225 from the mouth of the Higashi-kawa River in Misaki, Osaka Pref.; 158 from Tanigawa in Misaki, Osaka Pref.; 33 from the mouth of the Muko-gawa River in Nishinomiya, Hyogo Pref.; 19 from Koshien-hama in Nishinomiya, Hyogo Pref.; 17 from the mouth of the Shuku-gawa

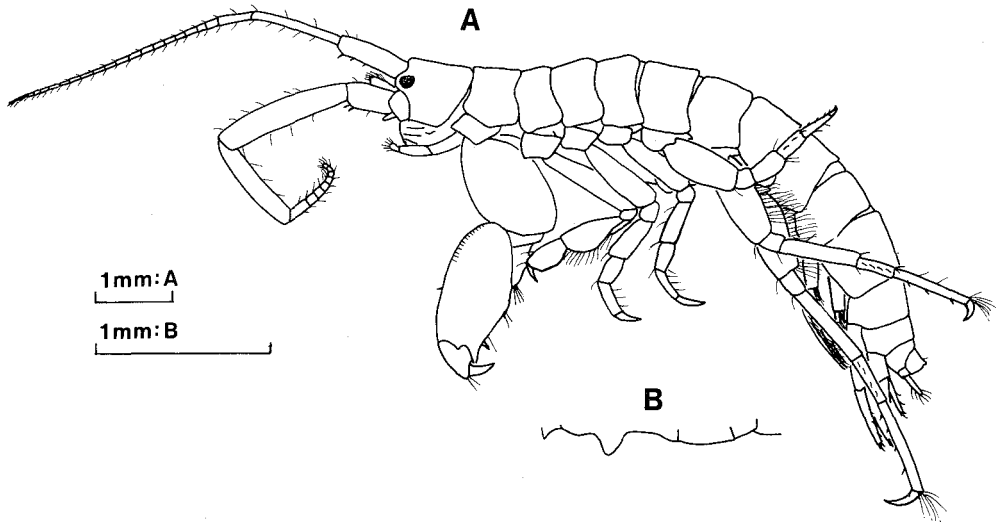


Fig. 16. *Grandidierella japonica* Stephensen. Male(1): A, habitus; B, ventral process of pereon segment 1 (lateral view).

River in Nishinomiya, Hyogo Pref.; 23 from the mouth of the Sumoto-gawa River in Awaji Island, Hyogo Pref.; 1 from the estuary of the Ki-no-kawa River in Wakayama Pref.

Male (1 and 2)

Body (Fig. 16-A): Subcylindrical; rostrum small; eyes ovoid, medium in size; pereon segment 1 (Fig. 16-B) with a ventral process.

Gnathopod 1 (Fig. 17-A): Extremely large, complexly subchelate; coxal plate rectangular; article 2 large, subovoid, 1.3 times as long as broad; article 3 short; article 4 somewhat elongate, posterodistal end setose; article 5 large, oval, 1.6 times as long as broad, anterior margin on inner surface with a row of transverse ridges (ca 40) and 3 spines; article 5 with 3 teeth, a strong tooth at posterodistal corner, a small accessory tooth on inner surface of anterior side of the strong tooth and a medium tooth on inner surface near posterior margin (Fig. 17-A1); article 6 ovoid, 0.4 times as long as article 5; dactyl medially expanded.

Gnathopod 2 (Fig. 17-B): Somewhat slender, subchelate; coxal plate trapezoidal; article 2 elongate, slightly dilated distally; article 4 narrowed distally, distal margin setose; article 5 pyriform, posterior margin setose; article 6 rectangular, about 0.75 times as long as article 5, palm almost transverse, defined by three spines, posterior margin with a spine (Fig. 17-B1); dactyl unguiform, inner margin serrate.

Female

Similar to male except the following respects.

Gnathopod 1 (Figs. 17-C,C1): Smaller than that of male, subchelate; article 2 about twice as long as broad; article 5 roundish trapezoidal, posterodistal corner with a spine; article 6 subovoid, shorter than article 5, palm oblique, defined by 5 spines; dactyl claw-like, inner margin serrate.

Gnathopod 2 (Figs. 17-D,D1): Similar to that of male, but article 2 broadened medially and palm transverse, defined by four spines.

Coloration in life

Eyes black; head, pereonites, pleonites and peduncles of antennae dark brown; flagella

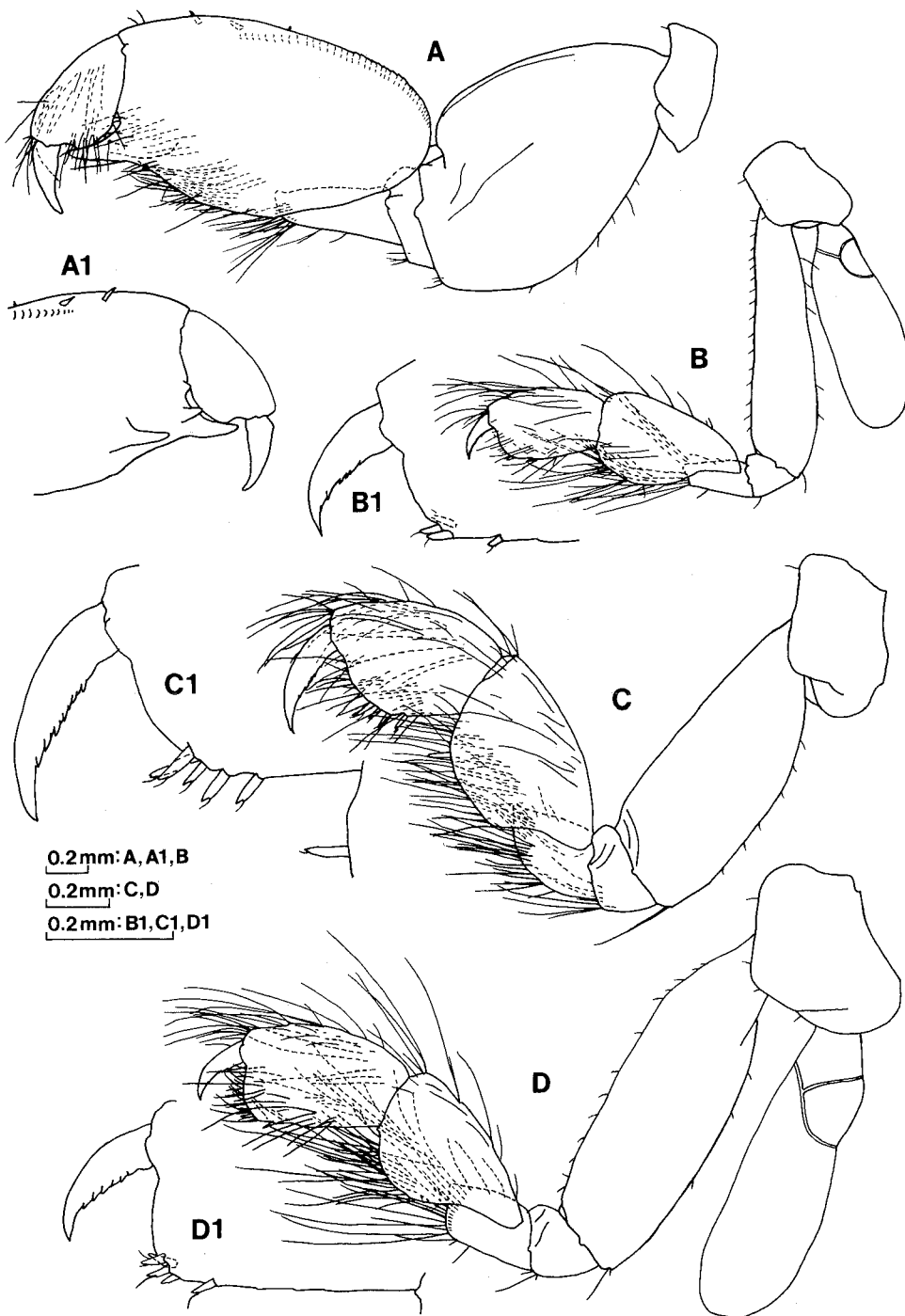


Fig. 17. *Grandidierella japonica* Stephensen. Male(2): A, gnathopod 1 (outer view); A1, distal part of gnathopod 1 (inner view); B, gnathopod 2; B1, palm and dactyl of gnathopod 2. Female: C, gnathopod 1; C1, palm and dactyl of gnathopod 1; D, gnathopod 2 (oostegite omitted); D1, palm and dactyl of gnathopod 2.

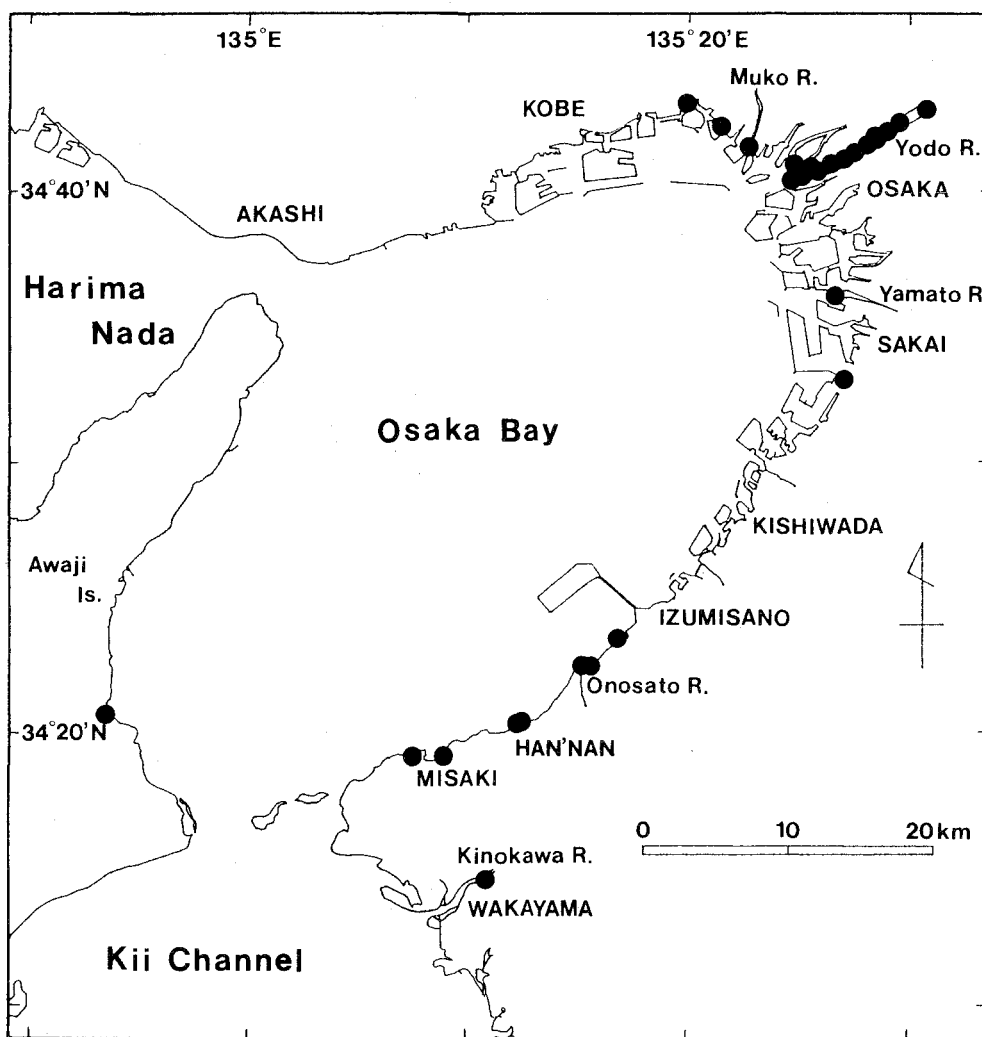


Fig. 18. Distribution of *Grandidierella japonica* Stephensen.

of antennae pale orange; other appendages whitish, article 6 of pereopods 3-4 with a orange vermiform spot.

Remarks

Morphological characters of the present specimens well agree with the descriptions and figures of Stephensen (1938), Chapman & Dorman (1975) and Hirayama (1984). This species is characterized by the transverse ridges on article 5 of male gnathopod 1. Four species having transverse ridges are known in *Grandidierella*, namely *G. japonica*, *G. perlata* Schellenberg, 1938, *G. taihuensis* Morino & Dai, 1990 and *G. vietnamica* Dang, 1968. However, *Grandidierella japonica* can be distinguished from the other species by the possession of three teeth on article 5 of male gnathopod 1.

Ecology

This species occurs in the mud bottom (rarely under stones) of lower intertidal zone and

shallow subtidal zone (up to 5 m depth), in the brackish and marine waters. Females brood from February to October.

Distribution

Around Osaka Bay and the estuary of the Ki-no-kawa River in Wakayama Prefecture (Fig. 18); Sakhalin (Kudrjaschov & Tzvetkova, 1975); from Hokkaido to Kyushu in Japan (Stephensen, 1938; Nagata, 1960, 1965; Hirayama, 1984); California (Chapman & Dorman, 1975) and Australia (Myers, 1981).

Crossing Experiments

At the mouths of the Oh-kawa River and the Higashi-kawa River in Misaki *Grandidierella fasciata*, *G. osakaensis* and *G. japonica* occur in the similar habitat. And the morphological characters of *Grandidierella fasciata* resemble well that of *G. osakaensis*. From these, there seems to be a possibility that *G. fasciata* or *G. osakaensis* is a hybrid between *G. japonica* and the other species. So, in order to confirm the absence of hybridization, I carried out crossing experiments among the three brackish species.

Grandidierella fasciata and *G. japonica* were caught from the mouth of the Higashi-kawa River, and *G. osakaensis* was caught from the mouth of the Oh-kawa River. Nine combinations of three species were tested. Three females after releasing juveniles and three males were introduced into beakers (vol. 1l) with sandy mud and brackish water (sal. 13.1). The water was aerated and not changed during experiments, and the average water temperature was 20.0°C. After rearing for 2 or 3 weeks, presence of juveniles was examined.

There were many juveniles in 3 beakers with females and males of the same species. But no juveniles were produced in 6 beakers with different species. This fact suggests the reproductive isolation among these species.

Acknowledgements

I would like to thank Dr. Hiroshi Morino of Ibaraki University and Dr. Shigeyuki Yamato of the Seto Marine Biological Laboratory for their kind advice and critical reading of the manuscript. I am also grateful to Mr. Ryohei Yamanishi of the Osaka Museum of Natural History, Dr. Hisashi Yokoyama of the National Research Institute of Aquaculture, and Mr. Masaki Sakaguchi of the Nishinomiya-higashi Highschool, who donated some materials.

References

- Barnard, J.L. 1970. Sublittoral Gammaridea (Amphipoda) of the Hawaiian Islands. *Smithson. Contr. Zool.*, 34: 1-286.
- Barnard, J.L. 1977. The cavernicolous fauna of Hawaiian lava tubes. 9. Amphipoda (Crustacea) from brackish lava ponds on Hawaii and Maui. *Pacific Insects*, 17: 267-299.
- Barnard, J.L. & Karaman, G.S. 1991. The families and genera of marine gammaridean Amphipoda (except marine gammaroids). *Rec. Austr. Mus., Suppl.*, 13 (Part 1 and 2): 1-866.
- Barnard, K.H. 1935. Report on some Amphipoda, Isopoda, and Tanaidacea in the collections of the Indian Museum. *Rec. Indian Mus.*, 37: 279-319.
- Chapman, J.W. & Dorman, J.A. 1975. Diagnosis, systematics, and notes on *Grandidierella japonica* (Amphipoda: Gammaridea) and its introduction to the Pacific coast of the United States. *Bull. Sth. Calif. Acad. Sci.*, 74(3): 104-108.
- Chevreaux, E. 1925. Voyage de la goélette *Melita* aux Canaries et au Sénégal 1889-1890. Amphipodes I-Gammariens (*suite*). *Bull. Soc. Zool. France*, 50: 365-398.
- Coutière, H. 1904. Sur un type nouveau d'Amphipode, *Grandidierella mahafalensis*, provenant de Madagascar. *Bull. Soc. philomath. Paris, sér. 9*, 6: 166-174.
- Dang, D.N. 1968. Nouveaux amphipodes des eaux douces et saumâtres du Nord Viet Nam. *Zool. Zh.*,

- 47(2): 212-222. [In Russian]
- Hirayama, A. 1984. Taxonomic studies on the shallow water gammaridean Amphipoda of West Kyushu, Japan. II. Corophiidae. Publ. Seto Mar. Biol. Lab., 19(1/3): 1-92.
- Ishimaru, S. 1994. A catalogue of gammaridean and ingolfiellidean Amphipoda recorded from the vicinity of Japan. Rep. Sado Mar. Biol. Stat., Niigata Univ., 24: 29-86.
- Kudrjaschov, V.A. & Tzvetkova, N.L. 1975. New and rare species of Amphipoda (Gammaridea) from the coastal waters of the South Sakhalin. Zool. Zh., 54(9): 1306-1315. [in Russian]
- Ledoyer, M. 1982. Crustacés amphipodes gammariens familles des Acanthonotozomatidae a Gammaridae. Faune de Madagascar, 59(1): 1-598.
- Morino, H. & Dai, A.Y. 1990. Three amphipod species (Crustacea) from East China. Publ. Itako Hydrobiol. Stn., 4: 7-27.
- Myers, A. A. 1970. Taxonomic studies on the genus *Grandidierella* Coutière (Crustacea, Amphipoda), with a description of *G. dentimera*, sp. nov. Bull. Mar. Sci., 20: 135-147.
- Myers, A.A. 1981. Taxonomic studies on the genus *Grandidierella* Coutière (Crustacea, Amphipoda). III. Fijian, Australian and Saudi Arabian species. Bull. Mus. natn. Hist. nat., Paris, 4^e sér., 3, section A, n° 1: 213-226.
- Myers, A.A. 1995. The Amphipoda (Crustacea) of Madang Lagoon: Aoridae, Isaeidae, Ischyroceridae and Neomegamphopidae. Rec. Austr. Mus., Suppl., 22: 25-95.
- Nagata, K. 1960. Preliminary notes on benthic gammaridean Amphipoda from the *Zostera* region of Mihara Bay, Seto Inland Sea, Japan. Publ. Seto Mar. Biol. Lab., 8(1): 163-182.
- Nagata, K. 1965. Studies on marine gammaridean Amphipoda of the Seto Inland Sea III. Publ. Seto Mar. Biol. Lab., 13(4): 291-326.
- Schellenberg, A. 1938. Litorale Amphipoden des tropischen Pazifiks. Kungl. Svenska Vetenskapsakad. Handl. 16(6): 1-105.
- Stephensen, K. 1938. *Grandidierella japonica* n. sp., a new amphipod with stridulating (?) organs from brackish water in Japan. Annot. Zool. Japon., 17: 179-184.
- Stephensen, K. 1948. Amphipods from Curaçao, Bonaire, Aruba and Marguerita. Stud. Fauna Curaçao, 3(11): 1-20.
-